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Notation Systems for Reading and Writing Sign Language

Amy L. McCarty

Without written forms, signed languages do not permit the type of textual record available to speakers of English and other written languages. Deaf signers have generally relied on the language of the dominant hearing culture for this purpose. Because of their visual-gestural modality, signed languages present a unique set of challenges for developing written forms. These issues are considered from a behavioral perspective, and two sign language notation systems, Stokoe Notation and Sutton SignWriting, are described.

The Deaf Culture

American Sign Language (ASL) has for generations been the native language of many deaf people of deaf parents, and is often the only language "spoken" in their homes. For some born-deaf people of hearing parents, as well as late-deafened individuals, ASL has also become the primary language. Many of these people make up a very sizable Deaf[1] Culture for whom "ASL is not only a first language but also carries with it the culture of generations of Deaf people in America.... ASL serves as the principle identifying characteristic of members of the culture and embodies the values and experiences of its users" (Humphries, Padden, & O'Rourke, 1980, p. 1).

Language is essential for transmitting complex concepts, such as the norms, sanctions, and mores associated with a culture, as well as its history and literature. ASL serves this function well when the speaker and listener are both present and in sight of one another, or through moving visual media such as film and video. However, there are many situations in which would-be speakers and listeners are not and cannot be within sight of each other. Written languages permit a relatively inexpensive permanent record that can be transmitted to people who are not in the presence of the writer, and can be made available to all members of a culture throughout current and future generations.

As an unwritten language, ASL does not permit this type of a textual record. Members of the Deaf Culture rely on the language of the dominant hearing culture, in our case, English. Many members of the Deaf Culture do not have functional English speaking or reading verbal repertoires, and are therefore unaffected by a written record of English or any other language. The absence of such a repertoire not only limits its access to information about the Deaf Culture, but about the world in general.

ASL, the language of the home and of the community, is the cornerstone of the Deaf Culture, and its members are very protective of both language and culture. Although their deaf children receive instruction in English at school, English remains at best a second language for them. Deaf children of deaf parents whose primary language is ASL cannot experience English receptively as hearing people do, and so cannot be affected by any correspondence between the auditory response products of their own vocal behavior and the auditory stimuli resulting from the vocal behavior of others. Although highly fluent in their own language, many do not become fluent speakers, readers or writers of English. A written form of the language in which they are fluent would provide the means for building literacy in that language.

A Behavioral Perspective

Skinner (1957) described six elementary verbal relations: mand, tact, intraverbal, echoic, textual, and the audience relation. The signer can mand, tact, make intraverbal responses, and is subject to audience control; and signing what is seen signed by another person is analogous

Send correspondence to Amy L. McCarty, 19 Old Mill Dr., Holland, MI 49423; phone: (616) 395-2690.

[1] Woodward (1972) proposed a convention of using the uppercase Deaf when referring to the Deaf Culture or its members. This convention is used here, and the lowercase deaf is used when referring to physical deafness.

to echoic behavior, but of course involving visual stimuli. However, there is currently no widely accepted sign analogy to textual behavior. Such a repertoire would require a set of visual stimuli that have point-to-point correspondence with the positions and movements of the hands, in the same way that the visual stimuli of a phonetic writing system have point-to-point correspondence with the sounds produced by the vocal apparatus.

Hearing children typically learn to read after they have already become relatively effective speakers and listeners. Then in school they acquire a textual repertoire consisting of unique vocal responses to the visual stimuli consisting of letters and words. In this process it is not necessary for the child to respond at first to the visual word stimuli in terms of their controlling variables, but only to produce a vocal response with an auditory response product, which will usually be a stimulus that already controls some behavior—the child hears the sound that he or she makes, and can respond as though the sound were made by someone else. This makes it possible for the child to react as a listener to completely new words by "sounding them out."

The textual repertoire plus being able to produce the written stimuli permits a child to behave as a "listener" without being in the presence of the person who produced the visual stimuli, and by producing such visual stimuli, behave as a "speaker" in the absence of the person spoken to. Literacy, being able to read and write, greatly improves the effectiveness of the controlling relations between the person and the person's environment.

In principle this process could work the same way for the deaf signer. Just like the hearing child, the deaf child raised in a sign environment ordinarily acquires a rather large repertoire as a signer, using hand and arm movements, body positions, facial expressions, etc. to verbally control the behavior of others; and also learns to react appropriately to the visual stimuli produced by the signing behavior of others. The deaf child could then acquire a repertoire of hand and arm movements, body positions, facial expressions, etc., under the control of written or printed visual stimuli consisting of the elements of an analog to the letters and letter combinations that control the hearing child's elementary textual repertoire. There would even be an analogy to the hearing child's "sounding out" an unfamiliar word, as the deaf child produced a sign as a result of an unfamiliar printed stimulus, and then reacted to what the sign looked like.

Note that this process cannot work for the same deaf child trying to learn to read English. The child's extensive sign repertoire that is the basis for functioning effectively as a "speaker" and "listener" in a signing environment has almost no correspondence with any written English letters or words. The visual stimuli that make up a written word have point-to-point correspondence with the sounds that are produced as a person pronounces the word, but those sounds are not available to the deaf child, and none of those visual stimuli have any correspondence with the elements of the child's sign repertoire. The child would have to learn to read and write English the way a person learns to read and write with a completely nonphonetic language system. Of course, the child's signing verbal community (parents, friends, teachers) could use signs to teach the child to react to written words as a "listener" and to write words and sentences under the control nonverbal stimuli and events in the child's social and physical environment. But this process is much slower and generally less effective than the ones governing the hearing child's acquisition of the textual repertoire.

Sign Language Notation Systems

There have been a few attempts at developing a standardized notation system specifically for signed languages (Stokoe, Casterline, and Croneberg, 1965; Sutton, 1981; Teuber, as cited in Tucek, 1982; Tucek, 1982). Notation systems developed originally for other purposes have also been suggested for use with ASL (Bliss, 1965, as cited in Tucek, 1982; Charteris, 1972; Schlesinger, 1972). Of the various systems that have been developed, the Stokoe and Sutton systems are probably the most well known of those that are actually in use. Following is brief description of each. (For a more detailed comparison, see Martin, 2000.)

Stokoe notation. William Stokoe and his associates (Stokoe, 1960; Stokoe, Casterline, & Croneberg, 1965) developed a notation system to bring signed languages to the attention of the linguistic community, and to prove using traditional linguistic methods that ASL was a language in its own right (Stokoe, 1978). They

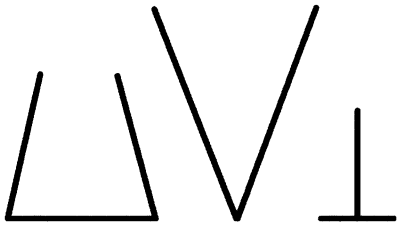

Figure 1. Stokoe notation for the sign *see.* Symbols, from left to right, are the tab symbol representing the mid-face (nose and eye area); the dez symbol representing the "V" handshape from the manual alphabet; and the sig symbol indicating horizontal movement away from the signer.

devised an orthography of symbols to represent discrete units of three dimensions of ASL; location, shape, and movement. Every sign in ASL comprises these three dimensions, which recombine to produce a variety of signs. The discrete units, which Stokoe termed *cheremes,* are equivalent to the phonemes of spoken language. Tab (from tabula) cheremes represent the location in which the sign is made; dez (from designator) cheremes represent the handshape or configuration of the sign; and sig (from signation) cheremes represent the movement of the hand or hands. Signs are written according to the formula TDs, with T, D, and s, representing tab, des, and sig, respectively.

Consider the ASL sign for *see.* Stokoe notation for this sign is illustrated in Figure 1. The tab symbol represents the location of the sign (mid-face region). The dez symbol represents the handshape (a *V* in the manual alphabet). The sig symbol indicates horizontal movement away from the signer. Just as the Roman letters in the word *see* correspond to (a) movements of the vocal musculature in producing the vocal response see, (b) kinesthetic stimulation associated with those movements, and (c) auditory stimuli produced by saying "see," the symbols in Stokoe notation for the sign *see* correspond to the (a) movements of the skeletal musculature in producing that signed response (b) kinesthetic stimulation associated with those movements, and (c) visual stimuli produced.

The Stokoe system is concise, comprising 12 tab symbols, 19 dez, and 24 sig for a total of 55 symbols (a computer font is available at http://www.panix.com/~grvsmth/stokoe/). The system has some drawbacks. In addition to the three dimensions identified by Stokoe, palm orientation, contacting region, hand arrangement, and temporal factors are also critical dimensions of signing (Battison, 1974; Battison, 1978; Friedman, 1977; Klima, 1975; Klima and Bellugi, 1979; Newkirk, 1975, as cited in Honda, 1981) as are facial expressions and other body movements that contribute to, and sometimes determine, the meaning of the signs. Another issue is that the system has no convenient cursive form for writing longhand.

Sutton SignWriting. Whereas Stokoe described his purpose in developing a notation system as to bring sign language to the attention of linguistic researchers (1978), Valerie Sutton (1981) developed a different notation system intending that it be adopted by deaf signers as a script for writing in their own languages. Her system is based on notation previously developed to represent elements of dance choreography. Hand, arm and body movements and positions, palm orientation, signing space and planes, facial expressions, punctuation, and grammar are all depicted pictorially such that any sign language in the world could be represented by this system. (Sutton's system is, in fact, in use by pockets of deaf signers in several countries).

The sign for *see* when written in SignWriting (see Figure 2) depicts the face and eye area; a fist with the middle and index fingers extended in a V; the palm facing the body; and forward movement of the hand. SignWriting notation for the sign *who*? is illustrated in Figure 3. The

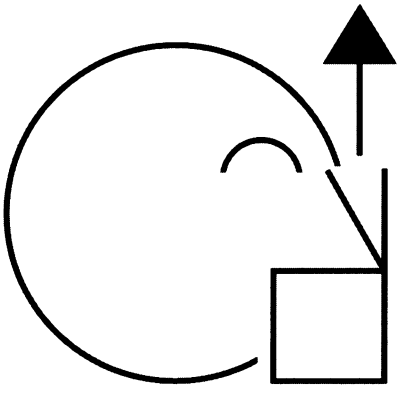

Figure 2. Sutton SignWriting notation for the sign *see.* The small half-circle within the larger circle represents the face and eye area. The symbol in the bottom right of the figure depicts the handshape and palm orientation. (outlined = palm facing body, solid = palm facing away from body) in the sign *see.* The arrow indicates forward movement of the hand.

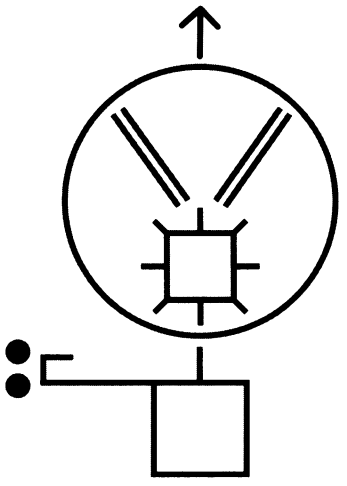

Figure 3. Sutton SignWriting notation for the sign *who?* The symbols in the eye and mouth areas represent eyebrows squeezed together and pursed lips. The arrow indicates a slight forward tilt of the head. The bottom symbol represents the handshape and palm orientation, and the two dots indicate a double movement of the extended index finger.

eyebrows are squeezed together; the lips are pursed; the head is tilted forward slightly; the hand is a fist with the index finger extended; the palm faces the body; and the index finger retracts and extends in a double movement. Sutton's symbols are actually symbolized pictures of the signs and could be conceptualized as individual frames of a motion picture of the signer.

SignWriting represents ten dimensions of signed language (hand, movement, face, head, upper-body, limb, full-body, location, dynamics, and punctuation) with 55 groups of symbols that can be combined into innumerable configurations. The Stokoe system, on the other hand, consists of only 55 symbols[2] and specifies a set configuration of symbols for each sign, just as we have a specific spelling for each English word. When we speak or write descriptively in English, we add modifiers and other descriptive words. Signers, on the other hand, usually modify the sign itself rather than adding other signs as modifiers. This is analogous to changing the spelling of a word instead of adding other word modifiers. The Stokoe system does not accommodate this modification of signs. With SignWriting, symbols and components of symbols can be turned, twisted, shaded, re-positioned, etc., to depict even the slightest nuances in ASL. The number of SignWriting configurations is limited only by signers' abilities to contort their bodies into unique signs. (A full description of the symbols and their groupings is available online at http://www.signbank.org.)

As SignWriting use increases, users may find that it is not necessary to record details to the extent that the system allows. Rather than stipulating a particular level of detail, SignWriting developers have decided to let the system evolve naturally over time (Martin, 2000). They have devised a shorthand version enabling writers to record signs with just a few strokes. They have also developed a word processing program, available as free shareware from the SignWriting Web site (http://www.signwriting.org).

Practical Implications and Future Research

Will literacy in ASL enhance the lives of native signers, making them less dependent on others, enabling them to participate more fully in both Deaf and hearing cultures? This question, and others, will certainly be answered, whether by behavioral researchers, traditional linguistic researchers, or others. Following are some more specific issues and questions that might be addressed in future research.

1. Currently, most deaf students in America are taught using English texts. Would these students learn general topics better from texts written in their native language? Of course before this could happen such text material would have to be produced, but with computers this could occur rather quickly.

2. Would literacy in ASL facilitate a deaf signer's attempts to learn to read and write English? According to the SignWriting Literacy Project for Deaf Children (2001), it does, but empirical research is needed.

3. What is the effect of a textual verbal repertoire in ASL on the deaf signer's development of vocal and visual English repertoires?

[2] The same number, 55, is coincidental—there is no direct correspondence between the 55 Stokoe symbols and the 55 SignWriting symbol groups.

4. How valid are tests written in English for conducting behavioral assessments of the Deaf? Would a notation system for ASL enable objective evaluations of the validity of these instruments? If research reveals faulty validity, could ASL notation help clarify and pinpoint the problem: whether it is in the tests themselves, or in the administration of the tests, or both? If a problem is discovered, might written ASL offer a more effective medium for conducting such assessments?

5. Considering the major dimensions of ASL, what degree of precision is necessary for functional literacy? Although speed, volume, intonation, facial expressions, gestures, and other features of *spoken* languages add meaning to our utterances, they are not represented in our written forms. Stokoe's system represents only 3 major dimensions of ASL, whereas Sutton's represents 10 or more. A balance will have to be achieved between the accuracy of the system's representation of the signs, and the difficulty of learning and producing the written stimuli. What is an acceptable balance?

Conclusion

Until recently, members of the Deaf Culture had no means for recording the history, literature, prose or poetry of their culture in its native language, and had no native language literature to read. Newsletters and magazines produced by and for Deaf people were written in the language of the hearing, as were text ooks and storybooks. Deaf students had to take notes in English, whether teachers presented their material in English or ASL. Even to write one's own name, a Deaf person relied on the language of the hearing.

Stokoe's groundbreaking work set the stage for research and development in the areas of deaf literacy and sign language notation. Potential research topics abound, but little (if any) behavioral (or empirical research of any kind) is being conducted. In the meantime, Sutton SignWriting is evolving and has been adopted by many deaf people and schools throughout the world, much of it through the efforts of the SignWriting Literacy Project for Deaf Children (2001). Denmark, the first country to adopt SignWriting, has been using it in its school systems since 1982 (Bentzen, et al., 1985, cited in SignWriting in Denmark). SignWriting has been part of the curriculum for deaf students in the Albuquerque (New Mexico) Public School District since 1999 (Flood, 2002). In a large region of Nicaragua, a signed language and a writing system are evolving together as there was no such language in that area until a few years ago—deaf people either went without or developed home signs (Gangel-Vasquez, 1997). Although none of this work is founded in Behavior Analysis, the topic is ripe for analysis from a behavioral perspective.

[Anyone wishing to communicate on this topic or any aspect of sign language can use the editor's e-mail address, jack.michael@wmich.edu.]

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